Space Weather Technical Forecast

Issued on Wednesday, 18 October 2023 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Weak CME arrivals possible, with a slight chance of isolated G1/Minor Geomagnetic Storm intervals throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, with isolated weak C-flares. Peak flare was C1.6 from a region beyond the NW limb. There are currently three numbered regions on the visible disc and two unnumbered regions, all of which are relatively small and simple. A CME that left the Sun around 18/0300 UTC has been analysed to be far-sided. There is the potential for an Earth-directed component from a small CME associated with a dimming event on the southeast of the disc around 18/0600 UTC, this is low confidence. Enlil modelling of these recent ejections are not yet available. No other Earth-directed CMEs occurred in this period.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE were indicative of background slow-ambient winds around 280-300km/s. Wind speeds increased around 18/0200 UTC to 320-340km/s following a slight discontinuity and have subsequently risen to around 360 km/s. The increase in wind strength may be a result of connection to the awaited HSS from CH60/+. Density was below average until around 17/2200 UTC, following a discontinuity, density increased to average to above average peaking at 13ppcc at 18/0700 UTC. Since 18/0900 UTC density has dropped to below average levels once more. The interplanetary magnetic field (IMF), Bt, was predominantly weak, but since around 18/0200 UTC has seen a gradual increase, peaking at 10nT at 18/1016 UTC. The important north-south component, Bt, was also weak, initially weakly fluctuating -1nT to +1nT, fluctuating more significantly from around 18/0200 UTC between -8nT to +6nt. Phi angle was negative (towards the Sun) but rotated to positive (away from the Sun) around 17/2200 UTC where it has since largely remained. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at Background. GOES16 high energy (greater than 2MeV) electron flux was at Background throughout. Associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 18/0000UTC was 2.04e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Very Low activity expected. There is a slight, but perhaps increasing chance of isolated M-flares through the period, with the possibility of a returning region on Day 4 (21 Oct) and development on the disc.

Solar Wind / Geomagnetic Activity: There are four CMEs with potential Earth-directed components, and two that are yet to be modelled by Enlil. Two from filament eruptions on 14 Oct may combine to give a glancing blow on Day 1(18 Oct). Further glancing impacts are also possible late Day 2 or early Day 3 (19-20 Oct) from the CME originating with the C7.5 flare on 16 Oct, and late Day 3 or Day 4 (20-21 Oct) from a filament eruption on 17 Oct. All are low confidence.

Slow wind conditions are expected Days 1-2 with a likely transition into the fast wind of CH62/- Day 3. Some enhancement to slightly elevated levels possible from HSS or CME

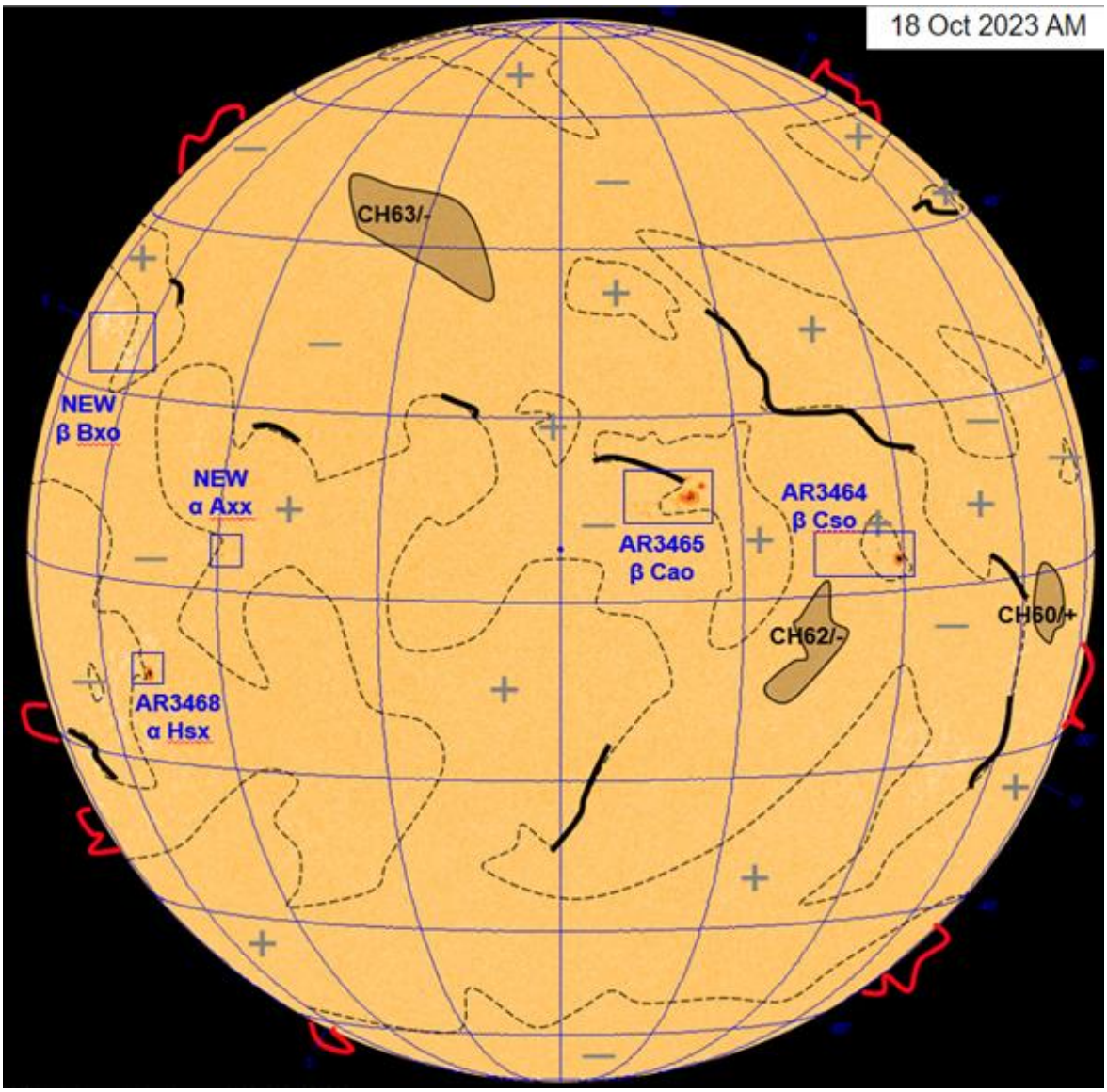
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

enhancements. Overall, mainly Quiet (Kp 0-2) geomagnetic activity is expected but with the potential for Unsettled (Kp 3) to Active (Kp 4) intervals. There is a very slight chance of G1/Minor Geomagnetic Storms (Kp 5) from any enhancements, this risk greatest either late Day 2 or Day 3 if the third CME arrival combines with any HSS enhancement.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux will most likely remain at Background levels. High energy electron flux (greater than 2MeV) is expected to be at background levels, perhaps rising to Moderate depending on the strength of any enhancement that occurs. The associated 24hr electron fluence is expected to remain below Active (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 18/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Geomagnetic Storms:

There are a number of weak CMEs that have the potential to glance Earth during the period. Two partial filament disruptions on 14 Oct may combine as a single arrival on Day 1 (18 Oct), although their arrival may be masked by the transition into a weak HSS from CH60/+, STEREO-A has shown a recent modest increase in density which may be attributed to a CME arrival. A third CME was observed from the C7.5 of AR3467 in the northeast disc on 16 Oct. The bulk of the material is modelled to miss, passing behind Earth, but with the chance of a slight glance either late Day 2 or more likely early Day 3 (19-20 Oct). A fourth CME was observed from a filament eruption near ex-AR3463 off the southwest disc early on 17 Oct. This is also expected to largely miss, passing ahead of Earth, but with the potential for a glancing impact either late on day 3 or day 4 (20-21 Oct).

All of these glancing blows are considered low confidence, as is reflected by the spread of values in Enlil Ensemble and in the low probability of any significant geomagnetic response.
Two CMEs from earlier Day 1 have been analysed and await Enlil modelling: a far-sided large and bright CME and a small CME, currently attributed to a dimming event from the southeast of the disc. Due to uncertainty in their trajectories, they have not been included in the Earthbound Coronal Mass Ejection table below.

Winds are expected to initially remain at ambient levels, but enhancement is possible to slightly elevated levels given any influence from CH60/+ or the subsequent arrival of a HSS from CH62/- later in the period. Further enhancements possible should any CME arrivals occur. SWPM is considered to be giving relatively poor guidance at this stage, with Enlil preferred for the forecast wind trend.

Overall, mainly Quiet geomagnetic activity is expected (Kp 0-2), with Unsettled (Kp 3) intervals and a chance of Active (Kp 4) intervals owing to the onset of a HSS from Day 3 (20 Oct) or if any glancing CME arrivals occur. There is a very slight chance of G1/Minor Geomagnetic Storms (Kp 5) through the period, with the greatest risk is late Day 2 or Day 3 (19-20 Oct) if the third CME arrives coincident with any CIR head of CH62/-, or within any associated fast wind.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	5	10	10	10
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

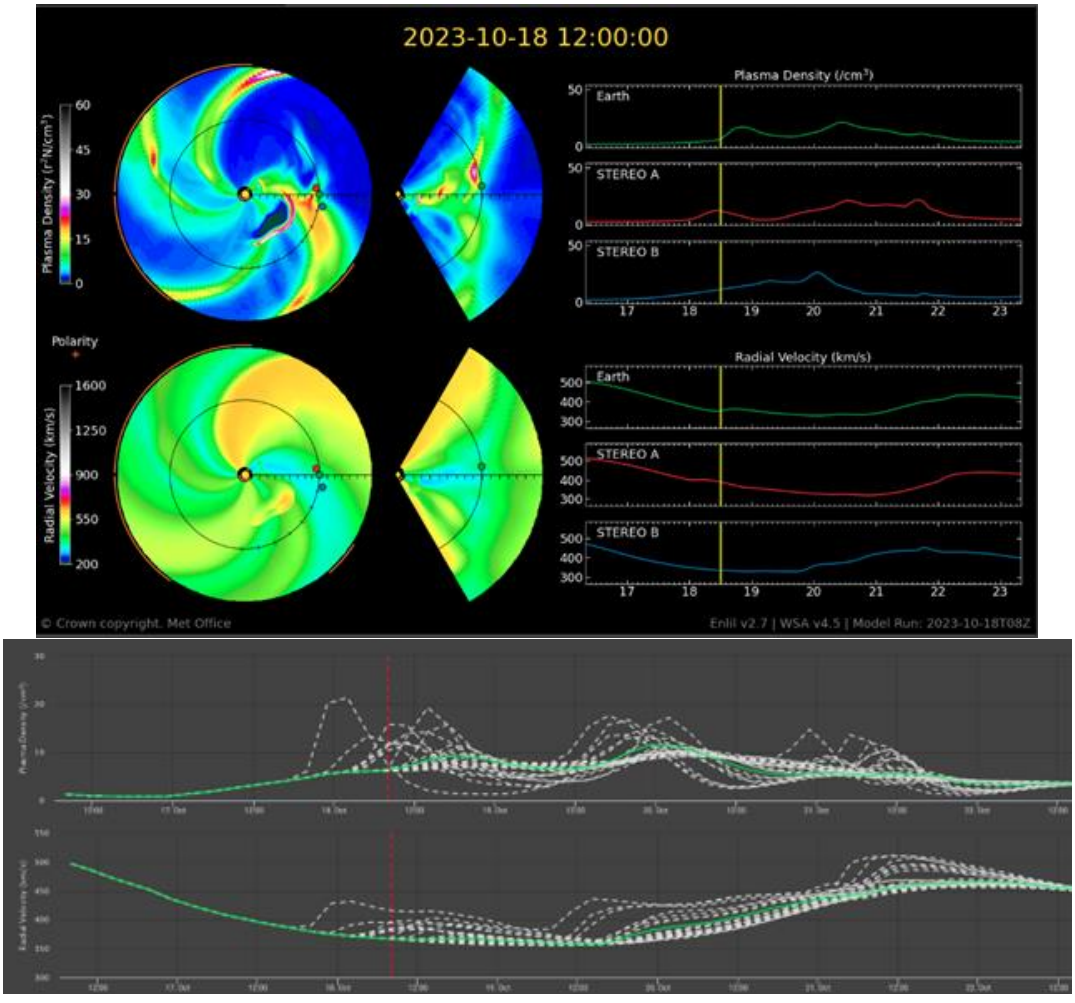
Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
14/1337	Partial	Filament	NW	448	18/0900 +/- 6hrs	Low confidence. Glancing blow.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

14/2152	Partial	Filament	NW	431	18/0900 +/- 6hrs	Low confidence. Glancing blow.
16/1730	Partial	C7.5 AR3467	NE	680	20/0100	Low confidence. Glancing blow.
17/1430	Partial	Filament	SW	420	21/0600	Low confidence. Glancing blow.

Figure 2: MOSWOC Enlil and ensemble, showing a wide spread of weak enhancements through the period.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

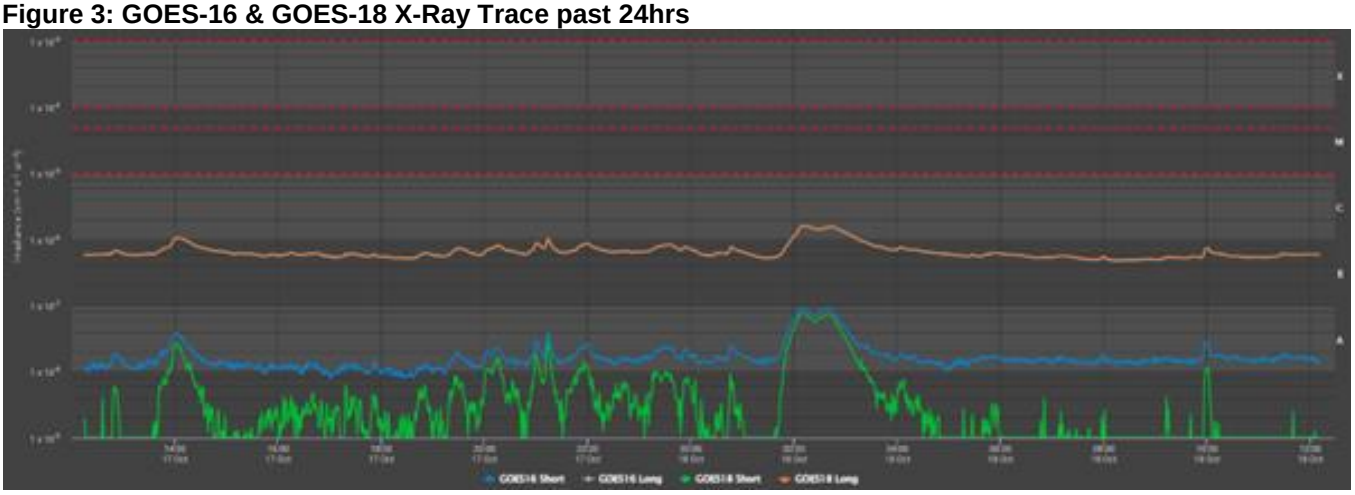
© Crown Copyright 2023. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
Activity is expected to remain Low to Very Low, with only isolated C-class flares likely in the absence of any further significant sunspot development. There are currently three numbered regions on the visible disc and two unnumbered regions. All the spots on the visible disc are small and simple.

AR3464(Cso/Beta) and AR3465(Cao/Beta) only retain bi-polarity and Beta classification due to the presence of some weakening pores on the trailing portion. Both regions remain stable.
While there is only a very slight chance of activity increasing to Moderate from the occurrence of any M-flares, this risk is increased slightly through period as a returning region may rotate onto the disc around Day 4 (21 Oct) and some development is likely to occur on the disc itself.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	20	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16 & GOES-18 X-Ray Trace past 24hrs



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at Background levels. Any increase to proton flux is unlikely, given the current visible sunspot activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
Electron flux observed by GOES-16 at GEO is currently at background levels. Solar wind enhancements are possible through the coming days, mainly associated with a number of potential CME arrivals throughout the period, or the onset of a HSS from small coronal hole CH62/- fast wind, most likely Day 3 (20 Oct). These are all low confidence however, and any enhancement is expected to be largely weak. These may increase electron populations through the Van Allen belts at times, which could bring periods of Moderate flux, most likely towards the end of the period.
The associated 24 hour fluence is expected to remain well below the Active threshold, although an increasing trend is likely, especially towards the end of the period, depending on the strength of any enhancements that occur. This is supported by REFM, however this will only provide good guidance in the absence of any CME or fast wind enhancements.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	1	1	1	5
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

Figure 5:

*

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.